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AUTHOR Rothenberg, Lori F.; Harrington, Charles F., II
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ABSTRACT

A model of research design anxiety reactions, that was adapted from the work of P. B. Cemen (1987) on mathematics anxiety reactions, was tested. The sample consisted of six classes of 152 master's degree students in a graduate educational research design course. Most were full-time teachers pursuing the master's degree part-time. Students were administered a variety of instruments to assess each aspect of Cemen's model. A questionnaire was developed to assess prior experiences, and students completed the Mathematics Anxiety Rating Scale and an instructor and course evaluation instrument, as well as the Intelligence subscale of the Adult Self-Perception Profile. Students also rated their anxiety about the course. Results showed that how one views one's own intelligence is inversely related to mathematics anxiety and is inversely related to anxiety about research design. However, none of these variables is related to achievement in research design. Prior experience with mathematics and science is not related to any variable studied. The study provides evidence for a portion of Cemen's model, with the measure of dispositional antecedents related to the anxiety reaction over research design. (Contains 35 references.) (SLD)

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The Relationship between Anxiety and Achievement in Adult Learners

Lori F. Rothenberg

Charles F. Harrington II

West Georgia College

Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA, April 4-8, 1994.

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"Research design. These words send chills down the spines of many graduate students in education..." (Slavin, 1992, p.2). Although models have been proposed to describe mathematics anxiety (Randhawa, Beamer, & Lundberg, 1993) and statistics test anxiety (Benson, 1989), there is a need for a more general model to describe "research design anxiety". Research design involves more than just mathematics and statistics. It also includes, for example, an understanding of the process of scientific inquiry. The purpose of the present study was to test a model of a research design anxiety reaction adapted from Cemen's (1987) work on mathematics anxiety reactions.

In examining the literature related to anxiety in research design courses, two distinct related strands of research appear. First, there is a large body of literature examining mathematics anxiety. Second, there is research examining statistics anxiety. No empirical studies of "research design anxiety" were located. However, a general model of an anxiety reaction has been proposed by Cemen (1987). Many of the general components of Cemen's model have been observed to be present in master's level students taking an educational research design course. In order to provide a background for the present study, the literature on mathematics anxiety in college students, the literature on statistics anxiety in college students, and Cemen's (1987) model will be

described.

Psychology has long acknowledged the debilitating effects of anxiety on learning and achievement (Levitt, 1980). As the need for mathematics skills has become increasingly more important in our society, studies of mathematics anxiety and mathematics achievement have proliferated. Descriptive studies have found that college students do report incidents of mathematics anxiety. Richardson and Suinn (1972) reported that over one-third of the students requesting help with anxiety in a university counseling program indicated anxiety about mathematics was a concern. Betz (1978) reported that over 50% of college students express feeling anxious about mathematics at some time. Variables that contribute to this mathematics anxiety have been studied. Among those variables that have been found to reinforce mathematics anxiety are a lack of foundation in mathematics (Burton & Russell, 1979), previous bad experiences with mathematics (Flessati & Jamieson, 1991), and low mathematics self-esteem (Smith, 1981).

Although there is empirical evidence to clearly support the existence of the construct "mathematics anxiety", the relationship between mathematics anxiety and mathematics achievement is not so clear. Many studies and reviews have documented an inverse relationship between mathematics anxiety and mathematics

achievement (Aiken, 1976; Richardson & Woolfolk, 1980; Tobias & Weissbrod, 1980; Harvey, Plake, & Wise, 1985). However, there have been other studies that have found mathematics anxiety was not significantly related to mathematics achievement (Dew, Galassi, & Galassi, 1983; Fulkerson, Galassi, & Galassi, 1984; Llabre & Suarez, 1985; Siegel, Galassi, & Ware, 1985). One interesting commonality across this latter group of studies was the use of undergraduate students as subjects. Harvey, et al. (1985) speculated that anxiety may be a more important factor for graduate students than undergraduate students.

Perhaps not surprisingly, another group of studies pursued the role of mathematics self-efficacy and its relationship to mathematics achievement and performance (Betz & Hackett, 1983; Hackett & Betz, 1989). Randhawa, et al. (1993) found that mathematics self-efficacy was a mediator variable between mathematics attitudes and mathematics achievement in high school seniors. In light of the research on mathematics self-efficacy, mathematics anxiety, and mathematics achievement, the exact role of mathematics anxiety in mathematics achievement appears to be quite complex.

The second strand of research that appears in the literature concerns statistics anxiety and statistics achievement. A few studies have examined mathematics anxiety and achievement in a statistics

course. Adams and Holcomb (1986) and Sime, et al. (1987) found a significant inverse relationship between mathematics anxiety and statistics achievement in their studies. Other studies have investigated the relationship between statistics anxiety and statistics achievement. Roberts and Saxe (1982), Sutarso (1992), and Benson (1989) found a significant inverse relationship between statistics anxiety and statistics achievement. Last, several studies have examined the relationship between statistics anxiety and other variables. Benson's (1987) and Benson and Bandalos' (1989) studies provided empirical evidence that statistics anxiety was related to, but different from test anxiety and mathematics self-concept and self-efficacy. Zeidner (1992) found that aversive prior experiences, prior poor achievement, and low mathematics self-efficacy were correlated with statistics anxiety. Sutarso (1992) found a significant relationship between statistics anxiety and statistics preknowledge, but no relationship between statistics anxiety and college mathematics background, gender, and ethnicity. Contrary to Sutarso's (1992) finding, Benson (1989) found that females had more statistical test anxiety than males. This parallels the similar contradictory findings concerning gender and mathematics anxiety (Zeidner, 1992). To further complicate this issue, Perney and Ravid (1990) found that achievement in an introductory statistics course was not related to

attitudes toward statistics, mathematics self-concept, mathematics background, or attitudes toward tests. Instead, most of the students attributed their success in the course to their instructor.

As can be seen from the literature, many variables have been examined in an attempt to understand mathematics/statistics anxiety and achievement. However, one thing lacking in most of the previous studies is a unifying theoretical model that explicates the relationship among all of these variables. Cemen (1987) proposed a comprehensive model that viewed mathematics anxiety as more than just a unidimensional construct. (See Figure 1.)

Insert Figure 1 about here

She viewed mathematics anxiety as having three anxiety components. Mathematics anxiety could be part of a relatively stable personality trait of anxiety proneness. It could just be a situational specific experience of anxiety. Finally, mathematics anxiety could be manifested as a sequence of cognitive, affective, and behavioral responses that occur as reaction to some form of stress. Her model requires the presence of both situational antecedents (e.g., way mathematics is taught, test anxiety,...) and dispositional antecedents (e.g., attitude, prior avoidance,...) in order for a

mathematics anxiety reaction to occur. Once the reaction occurs, cognitive reappraisal takes place, which leads to a form of coping (e.g., debilitation of mathematics performance, facilitation of mathematics performance, increase in anxiety,...). In addition, she identified environmental antecedents (e.g., negative mathematics experiences, lack of parental involvement,...) that influences the development of the dispositional antecedents. Cemen's (1987) full model has not been tested, but components of it have been examined. Since Cemen's model has not been tested yet with educational research design students, the purpose of this study was to test it in order to see if it applies to a broader variety of anxiety reactions than just mathematics anxiety reactions. Cemen's (1987) model may be a more general anxiety model than previously thought. It was hypothesized that the anxiety seen in educational research design would be related to discomfort with mathematics/statistics and science. Cemen's model was expended to include discomfort with science as well as mathematics. It was also hypothesized that this modified model would yield significant results for graduate students enrolled in an educational research design course.

Method

Subjects

The sample for the present study consisted of six classes of 152 master's students enrolled in a graduate educational research design course during the Winter and Spring quarters of 1993. Seventy-eight percent of the subjects were female and 22% were male. Ninety-four percent were white and 6% were African-American. The overwhelming majority of students were full-time teachers pursuing a master's degree part-time. Also, the overwhelming majority of students were 25 years or older.

Instrumentation

Mathematics Anxiety Rating Scale (MARS).

The Mathematics Anxiety Rating Scale (MARS) is a 98 item self rating scale. The items describe mathematical things that may cause apprehension to be rated on a 5-point scale ranging from "Not at all" to "Very much" anxiety. Examples of items include "Working on an income tax form" and "Reading the word "Statistics"". The MARS has a reported test-retest reliability coefficient of 0.78 and a coefficient alpha of 0.97 (Suinn, 1972). In addition, Dew, et al. (1983) reported that the MARS had good reliability. Evidence of content, concurrent, and construct validity are given in several sources (Suinn, 1972; Richardson & Suinn, 1972;

Brush, 1978). The MARS was used as a measure of situational anxiety - a situational antecedent in Cemen's (1987) model.

Adult Self-Perception Profile.

The Adult Self-Perception Profile is an instrument designed to measure the multidimensionality of adult self-concept. It measures 12 domains - sociability, job competence, nurturance, athletic abilities, physical appearance, adequate provider, morality, household management, intimate relationships, intelligence, sense of humor, and global self-worth. The intelligence subscale was used in the present study as a dispositional antecedent. "Items refer to feeling smart, understanding thing, and feeling intellectually capable" (Messer & Harter, 1986, p.5). The intelligence subscale has reported Cronbach's alphas ranging from .75 to .86. In addition there is construct validity evidence in the form of a factor analysis (Messer & Harter, 1986).

Prior Experiences Questionnaire.

A questionnaire was designed by the researcher to elicit information concerning prior experiences with mathematics and science. The 12 items refer to parental and peer encouragement of pursuit of mathematics and science, mathematics and science achievement below expectation, and negative academic experiences with mathematics and

science. Each item was answered using a 5 point scale ranging from "never" to "always". The higher the total score, the more positive the prior experiences. The questionnaire has a coefficient alpha of 0.82 (Rothenberg, 1993a). An exploratory factor analysis provided construct validity evidence (Rothenberg, 1994a).

Instructor/Course Evaluation Questionnaire.

The standard course evaluation questionnaire used by West Georgia College was used to measure students' perceptions of the instructor and course. Thirteen of the original sixteen items were used as a measure of a situational antecedent. "There was considerable agreement between the announced course objectives and what was actually taught" and "The instructor was considerate and courteous to students". Each item is rated using a 5 point scale ranging from 5 (strongly agree) to 1 (strongly disagree). The questionnaire has a coefficient alpha of 0.87 (Rothenberg, 1993b). An exploratory factor analysis provided some construct validity evidence (Rothenberg, 1994b).

Other measures.

Anxiety was measured by asking students to rate their level of anxiety about the research design course on a scale ranging from 1 (no anxiety) to 10 (extremely anxious).

Achievement was measured using the students final course grade

which was the average of a midterm and a final examination. The items on both examinations came from item banks. The KR20 reliability coefficient for the midterm was 0.96 and for the final was 0.97.

Procedure

Six classes of an introductory graduate educational research design course were taught during the Winter and Spring quarters of 1993. The course covered topics traditionally taught in an introductory research course such as: the process of doing research, some statistics, basic types of research, and critiquing the literature. The course was taught using a mixture of lecture, small group activities, and individual hands-on experiences. The primary method of instruction was lecture. Notes were taken on the content and delivery of each class period. the course content, method of instruction, textbook, instructor, and time of day the course met (all were night classes) were constant across all six classes.

Students were administered a variety of instruments in order to assess each aspect of Cemen's (1987) model. In order to assess environmental antecedents, the Prior Experiences Questionnaire was administered. In order to assess situational antecedents, students completed the Mathematics Anxiety Rating Scale and the Instructor/Course Evaluation Instrument. Dispositional antecedents were

assessed using the Intelligence subscale of the Adult Self-Perception Profile. Students were asked to rate their anxiety about the course on a 10 point scale at the beginning of the course as an indication of anxiety. Finally, coping was assessed by examining students' achievement in the course (average of the midterm and final examinations).

The Mathematics Rating Scale, the Adult Self-Perception Profile, and the Prior Experiences Questionnaire were all administered during the first two weeks of class. An outside person administered these instruments so that students would not feel pressured to participate in the study. (The first author of this study was the instructor for all six classes.) The midterm exam was given the fifth week of class each quarter. The Instructor/Course Evaluation Questionnaire was given the next to last class meeting.

Results

Figure 2 shows the path model for achievement derived from Cemen's (1987) model.

Insert Figure 2 about here

It was analyzed with multiple regression and the SAS JMP v. 2.0 package was used. Each new regression was entered sequentially,

according to the arrows drawn. Thus the sequence of operations was:

(1) Regress variable 6 on Variable 5, yielding p_{65}.

(2) Regress Variable 4 on both 5 and 6, yielding the paths (beta weights) p_{45} and p_{46}.

(3) Regress 3 on 4,5, and 6, yielding the paths p_{34}, p_{35}, and p_{36}.

(4) Regress 2 on 3,4,5, and 6, yielding paths p_{23}, p_{24}, p_{25}, and p_{26}.

(5) Regress the criterion Variable 1 on 2,3,4, and 5, yielding the four paths of direct influence on Achievement.

From each causal there are direct influences on Achievement, as shown. But there are also indirect influences. For example, Intelligence Self Concept directly influences Achievement with a force of 0.082. but Inteligence Self Concept also influences Achievement indirectly, via MARS, Class Factors, and Anxiety. Table 2 breaks down each correlation with Achievement into its causal components and its noncausal covariation. Table 1 displays the correlations among the variables.

Insert Table 1 about here

Insert Table 2 about here

In examining Table 2, Class factors has the largest influence on Achievement and as noted in Figure 2 the direct effect of Class Factors on Achievement is statistically significant. Class Factors contributes 6% of the variance in Achievement, out of the 13% explained by this model. The next largest direct effect on Achievement is Anxiety, but it is not statistically significant. One final observation in examining Figure 2 concerns the statistically significant relationships between Intelligence Self Concept, MARS, and Anxiety. The stronger one's belief in one's intelligence, the lower the mathematics anxiety. The stronger one's belief in one's intelligence, the lower the reported anxiety for research design. Finally, the higher the mathematics anxiety, the higher the anxiety over research design.

Discussion/Conclusions

The results of this study showed that how one views one's own intelligence is inversely related to mathematics anxiety and inversely related to anxiety about research design. Additionally, mathematics anxiety was directly related to research design anxiety. However, none of these variables were related to achievement in research design.

Instructors who teach introductory research design need to keep this in mind when beginning a course. Students need to be reassured about their own intelligence and they need to have a clear understanding of the role of mathematics in research design.

Prior experiences with mathematics and science was not related to any variables. The only variable that was significantly related to achievement was the way students perceived the instructor. Students who rated the instructor more favorably achieved at higher levels in research design. These results are very similar to those of Perney and Ravid (1990). Although it appears that the students' perceptions of the instructor was strongly related to the achievement of students in the present study, it is important to remember that this variable only explained 6% of the variance in achievement. Also, this entire model only explained 13% of the variance in achievement.

This study provided evidence for only a portion of Cemen's (1987) model. The measure of dispositional antecedents (Intelligence subscale of Adult Self-Perception Profile) was related to the anxiety reaction over research design. Also, one of the measures of situational antecedents (MARS) was related to the anxiety about research design. However, no evidence was found to support the link between between environmental antecedents and dispositional antecedents nor the link between anxiety

and achievement. An immediate recommendation for future research is to examine more closely the instruments used to measure each component of Cemen's (1987) model. In addition, multiple measures for each component could be administered to a larger sample and data analyzed using structural equation modeling. Finally, a measure of prior mathematics achievement (and/or science achievement) would have been helpful as a control variable in this study since achievement might covary with anxiety as a result of prior mathematics ability.

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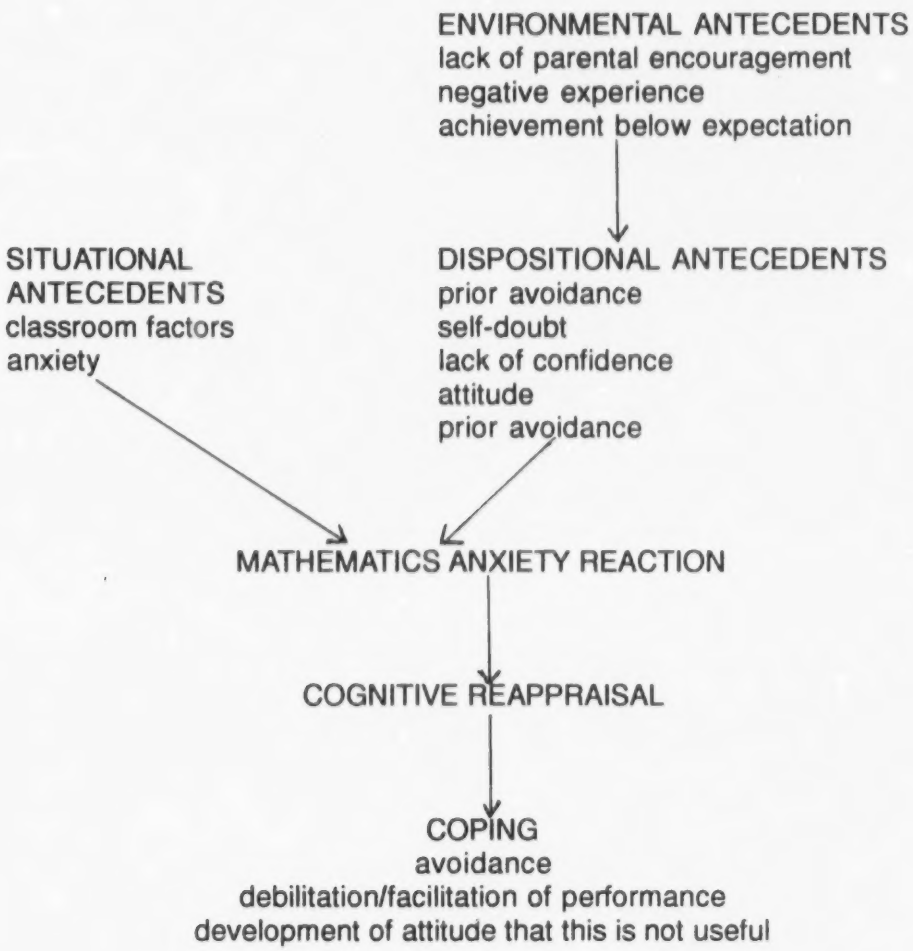

Figure 1. Cemen's (1987) Model of an Anxiety Reaction.

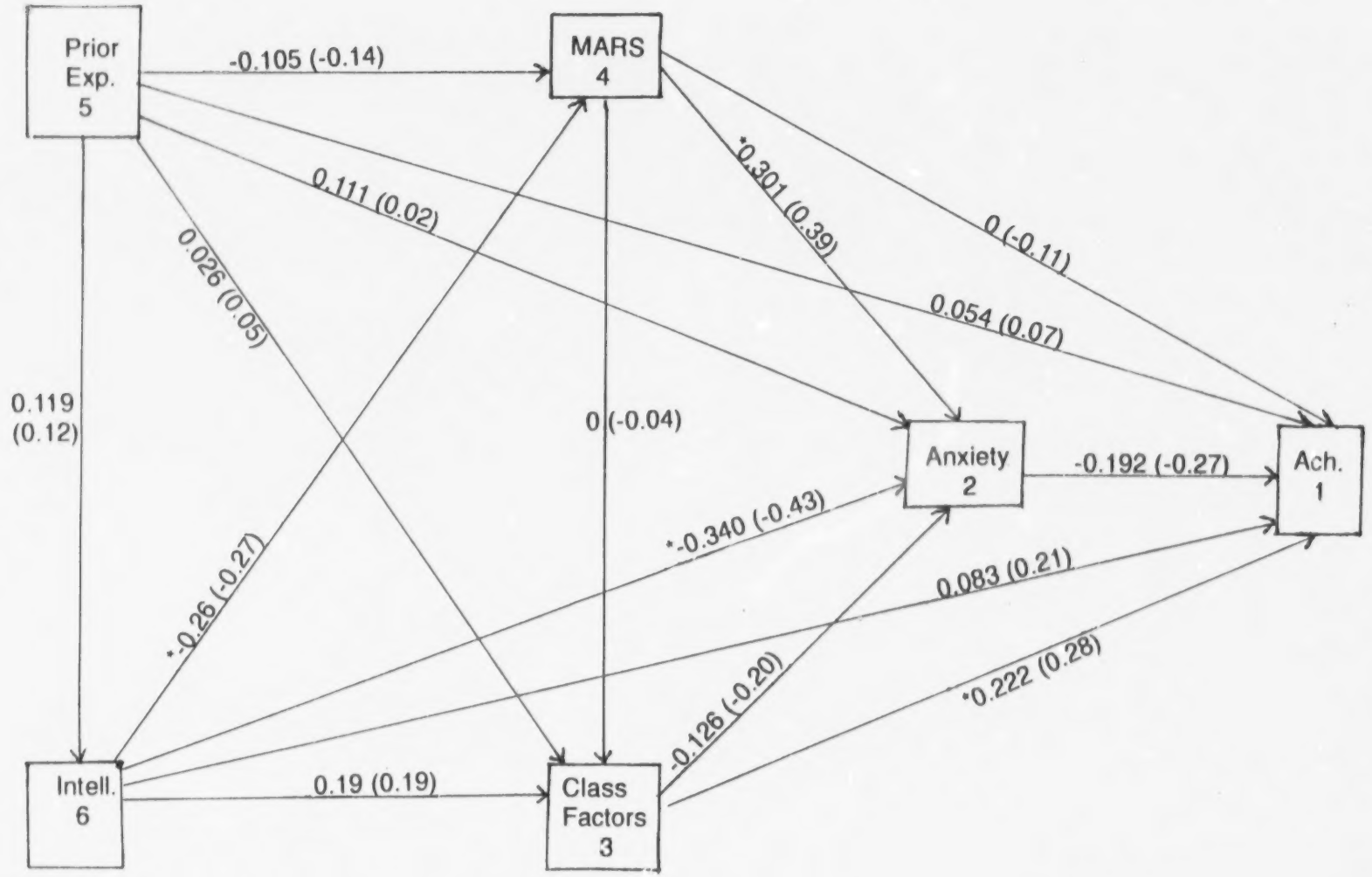

Figure 2. Path model showing achievement in research design.

Note: Paths are outside of parentheses (standardized coefficients); correlations are in parentheses.

*statistically significant $p<0.05$

	1	2	3	4	5	6
1. Achievement	1.00	-0.27	0.28	-0.11	0.07	0.21
2. Anxiety		1.00	-0.20	0.39	0.02	-0.43
3.Class Factors			1.00	-0.04	0.05	0.19
4. MARS				1.00	-0.14	-0.27
5. Prior Experiences					1.00	0.12
6. Intelligence Self-Concept						1.00

Table1. Correlations among variables.

Type of Relation	Anxiety	Class Factors	MARS	Prior Exper.	Intell.
Original correlation with achieve-ment	-0.270	0.280	-0.110	0.070	0.210
Causal-direct	-0.192	0.222	0	0.054	0.083
Causal-indirect	0	0.024	-0.054	0.007	0.112
Total causal	-0.192	0.246	-0.054	0.061	0.195
Noncausal covariation	0.078	0.034	0.056	0.009	0.015

Table 2. Causal components of achievement.